LINEARISER LU 1657
AND
POWER SUPPLY LS 1656

SOLARTRON

TECHNICAL MANUAL

MP MASTER
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LINEARISER LU1657

AND

POWER SUPPLY LS1656

TECHNICAL MANUAL

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CIRCUIT DIAGRAMS

Lineariser Program Unit
LU1657 Lineariser
Lineariser Power Supply
} at Rear of Manual

SECTION 1

GENERAL

Introduction

The unit, operating in conjunction with the Digital Voltmeter LM1420.2, linearises outputs from non-linear transducers. The resulting conversions are displayed and read-out by the Voltmeter in conventional units of measurement, e.g. °C. Alternatively, linear inputs to the Voltmeter may be scaled to any ratio between 1 : 1024 and 1023 : 1024.

To provide a versatile unit of compact dimensions, the correction circuits for separate types of transducer are built into plug-in Program Units, those available at present being listed in the Specification below.

The Lineariser is powered by its associated module, Power Supply LS1656.

Specification

Program Units: Any two may be fitted as part of the Lineariser, each providing (a) correction for one transducer calibration curve and (b) linear scaling for one input.

TABLE 1 - DETAILS OF PROGRAM UNITS

Type Number	Thermocouple or Thermometer	Temperature Range	Resolution	Maximum Linearisation Error
LX 1511	Iron/Constantan	-50°C to +230°C	0.1°C	±0.2°C
LX 1512	Iron/Constantan	- 5°C to +800°C	1.0°C	±0.5°C
LX 1513	Copper/Constantan	-130°C to +390°C	1.0°C	±0.5°C
LX 1514	Chromel/Alumel	-100°C to +1300°C	1.0°C	±0.5°C
LX 1515	Chromel/Alumel	-50°C to +230°C	0.1°C	±0.2°C
LX 1516	Platinum/Platinum (13% Rh.)	- 5°C to +1600°C	1.0°C	±0.5°C
LX 1517	Platinum/Platinum (10% Rh.)	- 5°C to +1600°C	1.0°C	±0.5°C
LX 1689	Copper/Constantan	-50°C to +230°C	0.1°C	±0.2°C
LX 1518	Platinum Resistance (130Ω/100Ω)	- 5°C to +1000°C	1.0°C	±0.5°C
LX 1519	Platinum Resistance (130Ω/100Ω)	-50°C to +230°C	0.1°C	±0.2°C

Inputs:

(a) Positive going -12V to 0V pulses from Digital Voltmeter LM1420.2V - F Converter.

(b) Polarity Signals from Digital Voltmeter LM1420.2; += -10V, -= 0V.

Outputs: Positive going -12V to 0V pulses to Digital Voltmeter LM1420.2 Counters

Control Signals:	Signals representing counts of 2300, 3995 and 3999 pulses from Digital Voltmeter LM 1420.2.
Command Signals:	(a) LINEARISE (b) SCALE (c) RELEASE DVM } -12V from system Scanner. (via system pin board)
Operating Temperature:	$0^{\circ}C$ to $50^{\circ}C$ Ambient.
Power Requirements:	95V to 130V or 190V to 260V, 50-60c/s. 20VA.
Weight:	71b. 2oz. (3.2kg) approx.
Dimensions: (Excluding front and rear panel fixtures).	5.25 in. x 4.25 in. x 14 in. (13.5cm x 11cm x 35,5cm)

NOTE:

1. All program units with the exception of types LX1516 and LX1517 use the x4 multiplier of the Voltmeter, whereas these two units work at x2. Thus, the conversion time of the Voltmeter is extended with consequent reduction in the maximum permissible scan rate.
2. Program units LX 1516 and LX 1517 have been written on the assumption that Thermometer Bridge LU 1462 is used in the system.

SECTION 2
OPERATION

Mounting Arrangements

The Compact Logger LY 1471 cabinet has been designed to accommodate eight modules of identical size on its two lower layers. One such module is the Lineariser LU 1657 and its position in the LY 1471 cabinet is second from the right on the lower layer, viewed from the front. Power Supply LS 1656 is housed in any spare quarter rack width space.

Each module slides into the cabinet space frame along lips on its side panels which act as runners, and is retained by a wing-nut at its rear.

Alternatively, a Mounting Rack, LX 1472, is available to house a maximum of four modules of Lineariser dimensions. It is intended for use in multi-layer systems, but can be provided as a separate item.

A metal case, designed to hold one Compact Logger module is also available.

Mains Selector Plug (LS 1656)

The Mains Selector Plug MSP1 is engraved with 115V and 230V markings and should be adjusted so that the metal pointer at the side of the module is opposite to the marking corresponding to the user's mains voltage rating. Pull the pivoted plug outwards to release it. Rotate it to the required position and replace it in its socket.

Mains Fuse (LS 1656)

Check that the mains fuse is correctly rated - 1A for 230V supplies and 2A for 115V supplies. The fuseholder is located between the Mains Selector Plug and Plug PLA.

Connector Details (LS 1656)

(a) Plug PLA

Mains power is applied through the fixed three way Bulgin plug PLA at the rear of the module, the positions of the line, neutral and earth pins being shown in diagram 1. No mains on/off switch is provided. In the Compact Logger or a similar system, power is switched to the all units in the system by operation of the Digital Voltmeter LM 1420.2 'POWER ON' switch.

Diagram 1. Fixed Rear Panel Connector PLA

(b) Socket SKTA

Transistor rail and relay supplies required by the Lineariser are directed from this socket to plug PLA, Lineariser.

TABLE 2. Socket SKTA(LS 1656) Details

Pin	Service
A	+12V
B	-24V
C	-6V
D	-12V
E	0V

Connector Details (LU 1657)

(a) Plug PLA

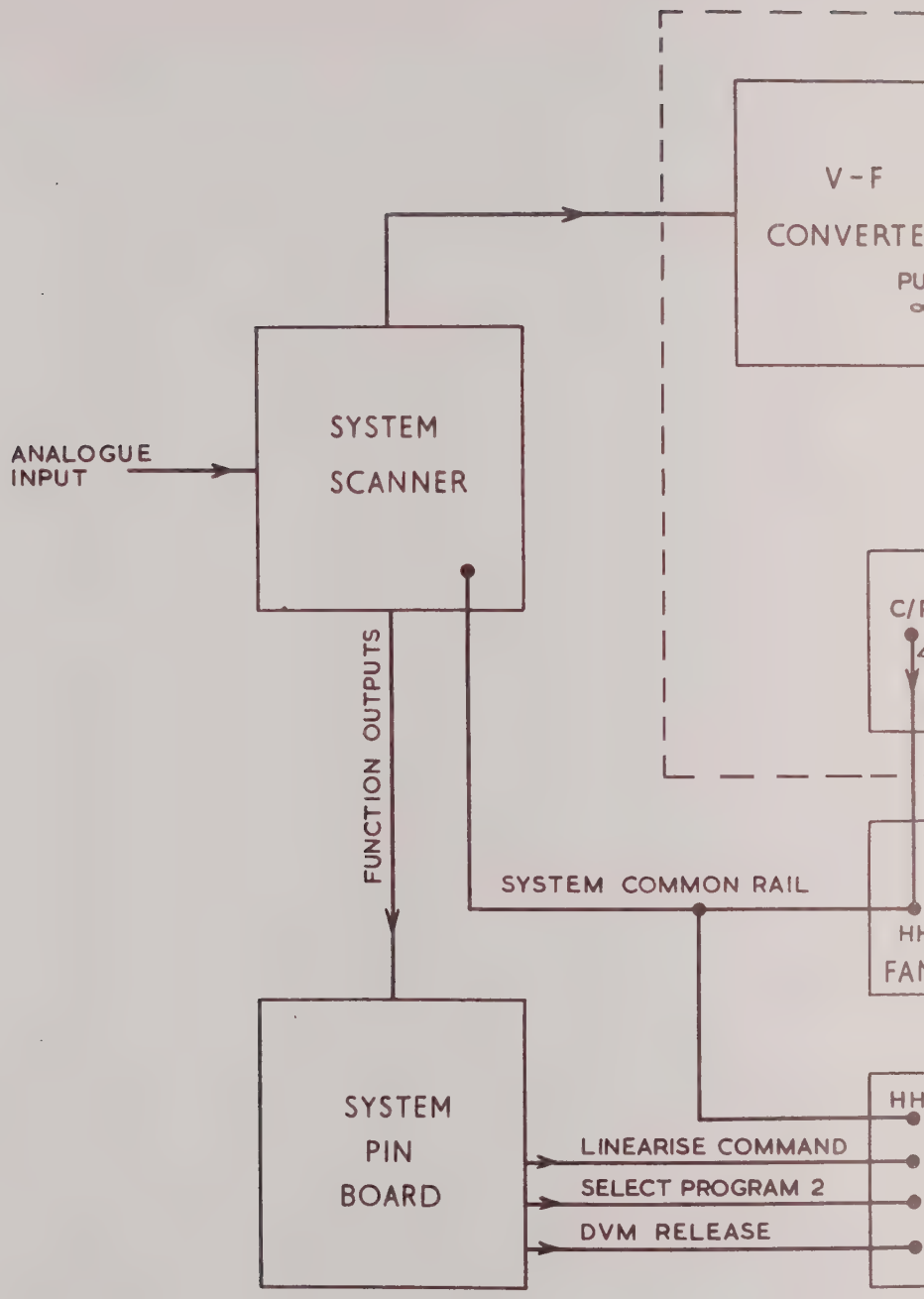
This is linked by cable to socket SKTA(LS 1656). Details are given above.

(b) Plug PLB

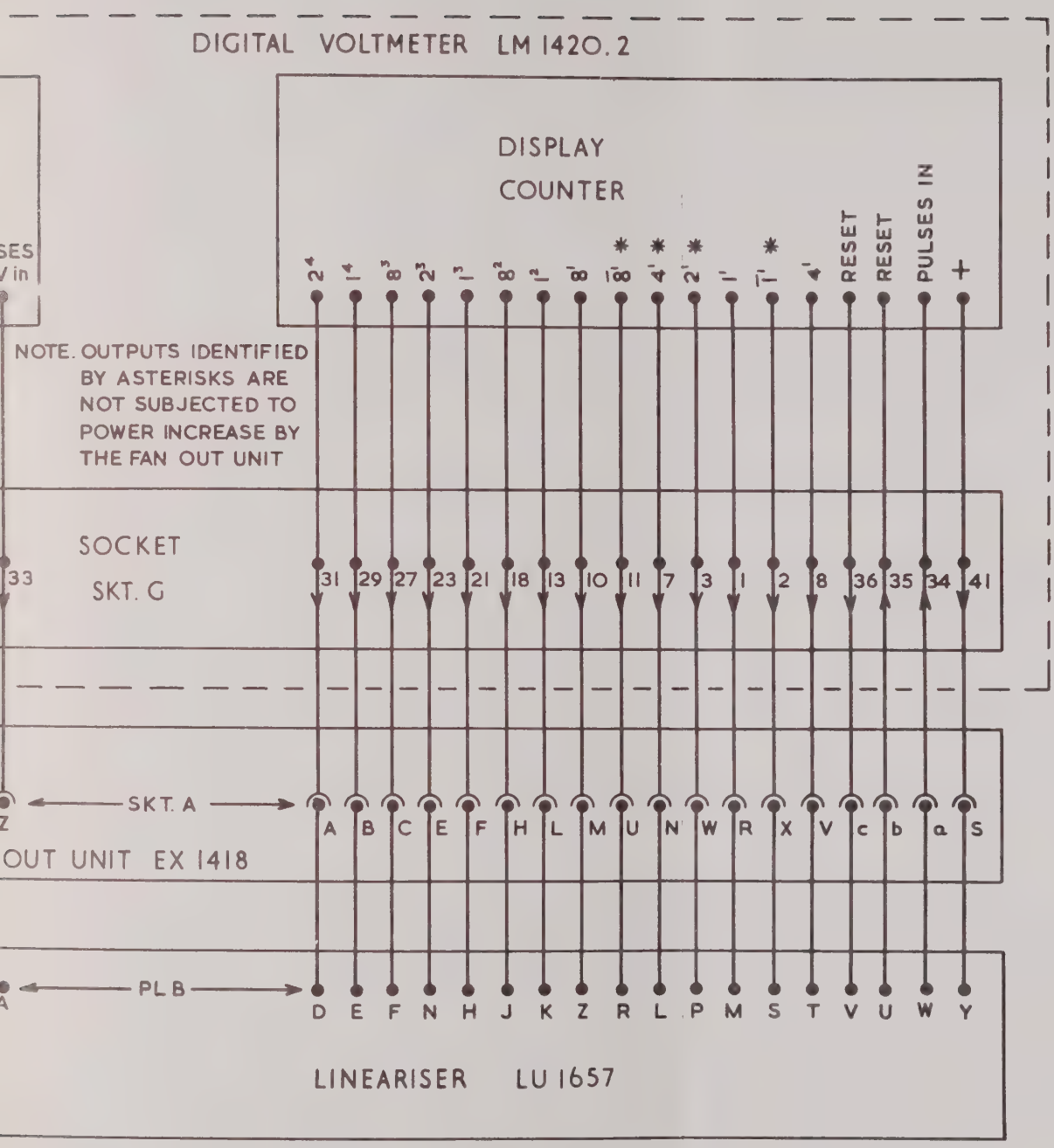
Digital Voltmeter LM1420.2 inputs and outputs (routed through Fan Out Unit EX1418) and command signals from a system Scanner (normally routed via a Pin Board) are applied to the 50 way AMP connector PLB at the rear of the Linearisers.

TABLE 3 - PLUG PLB DETAILS

Pin	Service	Remarks
A	Pulses from LM 1420.2 V-F Converter	From Pin Z, SKTA, Fan Out Unit EX 1418
B	Linearise Command	-12V level) See Table 3.
C	Select Program 2	-12V level)
D	2^4 Input from LM 1420.2)	
E	1^4 Input from LM 1420.2)	Information signals
F	8^3 Input from LM 1420.2)	subjected to power
H	1^3 Input from LM 1420.2)	increase by Fan Out Unit
J	8^2 Input from LM 1420.2)	EX 1418.
K	1^2 Input from LM 1420.2)	
L	4^1 Input from LM 1420.2)	
M	1^1 Input from LM 1420.2)	
N	2^3 Input from LM 1420.2)	
P	2^1 Input from LM 1420.2)	Information signals
R	$\bar{8}^1$ Input from LM 1420.2)	not subjected to power
S	$\bar{1}^1$ Input from LM 1420.2)	increase by Fan Out
T	4^1 Input from LM 1420.2)	Unit EX1418.
U	Reset to LM 1420.2	To pin b, SKTA, Fan Out Unit EX1418
V	Reset from LM 1420.2	From pin c, SKTA, Fan Out Unit EX1418
W	Output pulses to LM 1420.2 Counters	To pin a, SKTA, Fan Out Unit EX 1418
X	DVM Release	-12V level
Y	Polarity	+ = -10V level) from LM1420.2 via pin S, SKTA, Fan - = 0V level) Out Unit EX1418



INTERCONNECTIONS BETWEEN THE LINEA


DIGITAL VOLTMETER LM 1420.2
DISPLAY
COUNTER
RESET
RESET
PULSES IN
+
NOTE. OUTPUTS IDENTIFIED BY ASTERISKS ARE NOT SUBJECTED TO POWER INCREASE BY THE FAN OUT UNIT
SOCKET
SKT. G
31 29 27 23 21 18 13 10 11 7 3 1 2 8 36 35 34 41
SKT. A
A B C E F H L M U N W R X V c b a S
OUT UNIT EX 1418
PL B
D E F N H J K Z R L P M S T V U W Y
LINEARISER LU 1657

ISER AND ASSOCIATED UNITS DIAGRAM. 2

Pin	Service	Remarks
Z	8^1 Input from LM 1420.2	Information signal subjected to power increase by Fan Out Unit EX1418
HH	Common Rail	System Connection

The origin of pulses at pin A, PLB is pin 10, board 1 of the Voltmeter. The destination of pulses at pin W, PLB is pin 8, board 1 of the Voltmeter. Pins V and U, respectively, on PLB link with pin 5, board 1 and pin 20, board 2 of the Voltmeter.

Voltmeter Modification

Before fitting a Lineariser to a data logging system, ensure that the following links have been removed from the rear panel pinboard of Digital Voltmeter LM 1420.2

1. The Display Link at the top of the first (left-hand) column, viewed from the rear.
2. The Units Reset Link in the second column from the left, viewed from the rear.

Insertion of Program Units

Release the two retaining screws at the top corners of the right-hand side panel of the unit (viewed from the front). The side panel may now be hinged downwards. Insert the program units 1 and 2 into sockets SKT A and SKT B respectively at the rear of the front panel. Secure the units in position by means of two 4BA countersunk screws, fitted through the left-hand side panel.

Scaling Plugs

The PROG. 1 and PROG. 2 scaling sockets, located at the front of each program unit and projecting through the front panel of the Lineariser, may be fitted with pre-wired plugs to carry out scaling of linear inputs.

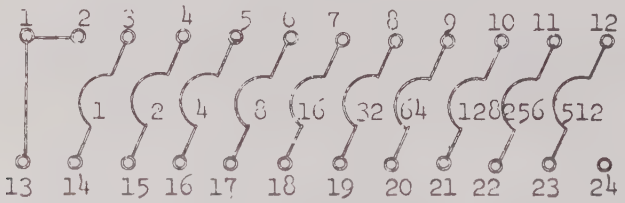


DIAGRAM 3 : Scaling Plug Link Weighting

Diagram 3 outlines the internal wiring to which each front panel socket is connected, the weighting of each link being shown within its loop.

To arrange any scaling ratio, the appropriate links must be connected in series by inserting a pre-wired plug into the required socket. For example, if a ratio of 826 : 1024 is to be used, connect plug pins 2 to 15, 4 to 17, 6 to 18, 7 to 19, 8 to 22, 11 to 23 and 12 to 24. Note that for any number, one end of the series must be linked to pin 2 and the other must be linked to pin 24.

Voltmeter Initial Calibration

When the Lineariser forms part of a system, the x1 and x2 positions of the Voltmeter display switch are used during calibration.

Method of Control

No operational controls are fitted to the unit. A remote method of control is used, whereby either of the two programs (i) linearises or (ii) scales an input to the Voltmeter.

Method of Control (continued)

Function signals from a system Scanner are routed through a system pin board (in multi-channel systems) as the channels are sequentially scanned. The signals, at -12V, are taken to pins B, C and X on plug PLB and command the Linearizer to carry out the following functions.

TABLE 4 - FUNCTION COMMAND

Pin(s) Energised	Lineariser Function
B	Linearise, using Program 1
B and C	Linearise, using Program 2
C	Scale, using Program 2
None	Scale, using Program 1
X	No Action

NOTE THAT IT IS ESSENTIAL TO RELEASE THE LINEARISER, BY ENERGISING PIN X, ON ALL CHANNELS WHOSE READINGS ARE NOT TO BE LINEARISED OR SCALED.

The various program units have been designed to operate while the Voltmeter multiplier is set to its x2 or x4 position. Details are provided in the following table, together with specified Voltmeter ranges.

TABLE 4 - VOLTMETER RANGE AND MULTIPLIER

DATA FOR PROGRAM UNITS

Type Number	Thermocouple or Thermometer	Voltmeter Range	Multiplier
LX 1511	Iron/Constantan	20mV	x4
LX 1512	Iron/Constantan	200mV	x4
LX 1513	Copper/Constantan	200mV	x4
LX 1514	Chromel/Alumel	200mV	x4
LX 1515	Chromel/Alumel	20mV	x4
LX 1516	Platinum/Platinum (13% Rhodium)	200mV	x2
LX 1517	Platinum/Platinum (10% Rhodium)	200mV	x2
LX 1689	Copper/Constantan	20mV	x4
LX 1518	Platinum Resistance (130 /100)	2V	x4
LX 1519	Platinum Resistance (130 /100)	200mV	x4

SECTION 3

TECHNICAL DESCRIPTION

General

The Lineariser presents the transducer reading in its conventional units of measurement (°C, p.s.i., etc.) on the display windows, and at the read-out points, of the Voltmeter.

Referring to diagram 4, the straight line graph represents the relationship between the output of a linear transducer and the pulse output of the LM 1420.2 V - F Converter. The dotted curve relates the output of a non-linear transducer with that of the LM 1420.2 V - F Converter.

The same diagram also shows the curve converted into a series of straight lines. This arrangement enables each segment of the curve to be considered separately, i.e., the curve may be treated as a series of slopes, each of which may be scaled separately.

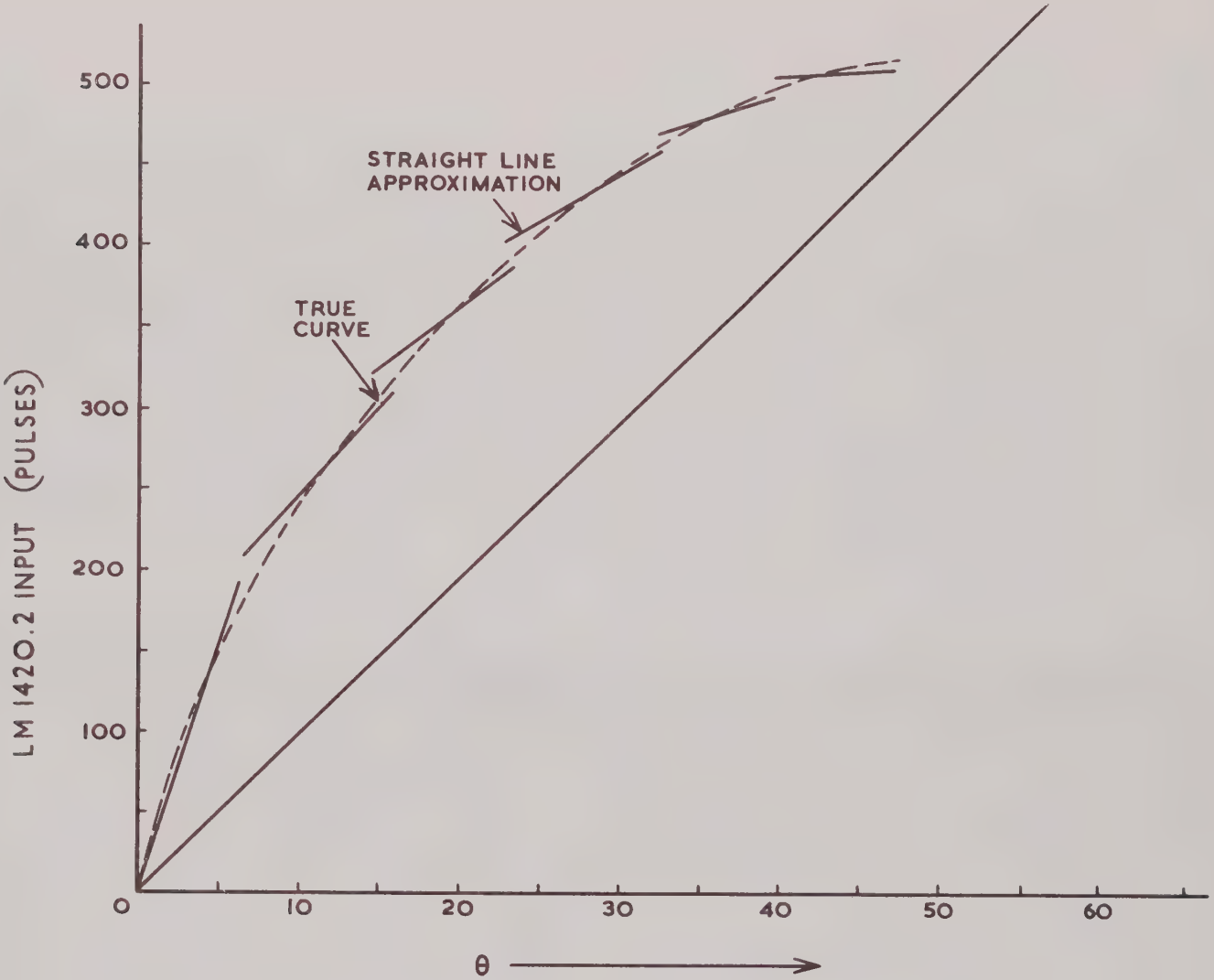
To scale voltage readings, it is necessary to gear down the V - F Converter pulses before they are allowed to accumulate in the display counter. The gearbox ratios may be determined for individual transducers from agreed standards. For example, the relationships between temperature and e.m.f. for thermocouples are determined from British Standard tables BS 1827 -1952.

The pulse frequency of the V - F Converter of the Voltmeter is directly proportional to its input, increasing as the input increases. At low frequencies, equivalent for example to low temperatures, only two or three segments will be scaled before the sampling period of the voltmeter is completed. At higher frequencies, further segments will be used. The Lineariser has been designed to handle a maximum of 15 segments of a transducer curve.

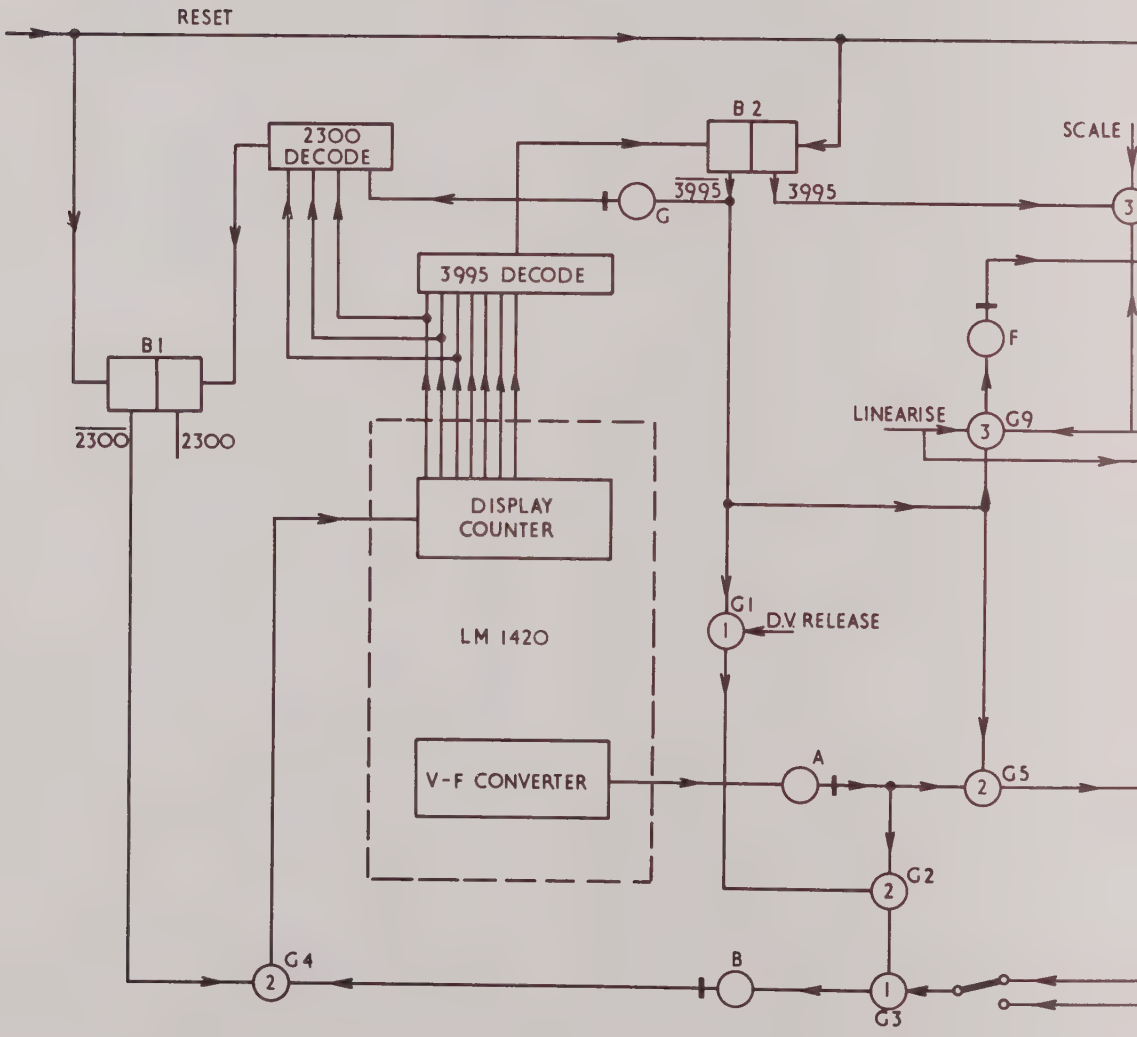
Logic Description (Diagram 5)

Linearisation

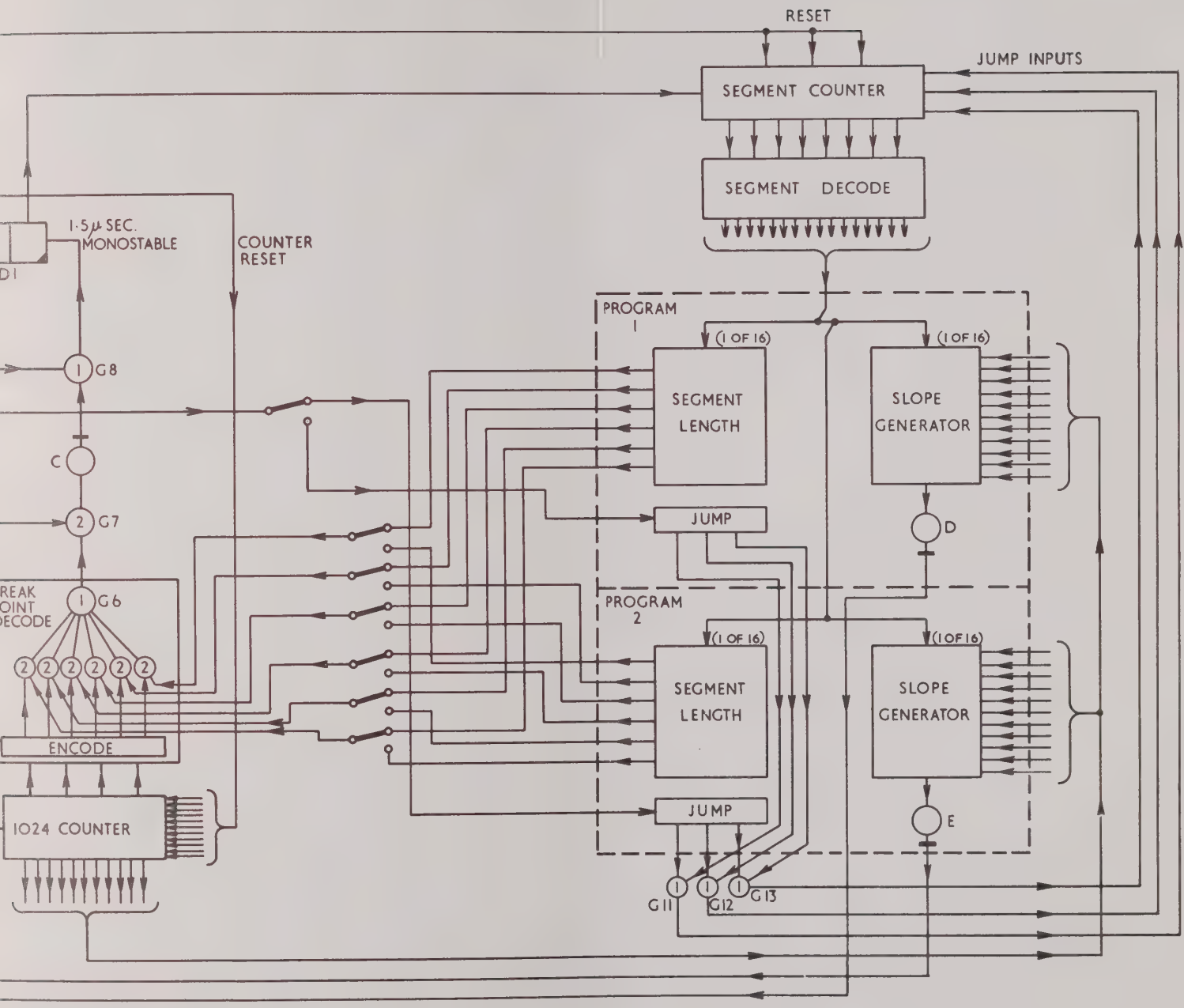
The control circuits of the voltmeter (fig.7, Digital Voltmeter LM 1420.2 manual) generate a reset pulse, which in normal voltmeter operation, is used to return the instrument counter circuits to zero.



TRANSDUCER / LM 1420.2 V-F CONVERTER RELATIONSHIPS DIAGRAM 4


RESET
2300 DECODE
B 2
SCALE
3995
3995
G
3995 DECODE
F
B1
LINEARISE
G9
2300
2300
DISPLAY COUNTER
LM 1420
G1
D.V RELEASE
V-F CONVERTER
A
G5
G2
G4
B
G3

LOGIC D



LINEARISER LU 1657

DIAGRAM 5

When the lineariser is attached to the voltmeter, the reset pulse is diverted to the former unit where it carries out the following functions during linearisation :-

1. The LM 1420.2 display counters are reset to 3803 (with the voltmeter multiplier set to x2; 3603 or 3203 if the x2 or x4 multipliers respectively are in use).
2. The 2300 bistable B1 is turned over to its 'not 2300' state.
3. Bistable B2 is turned over to its 'not 3995' state.
4. The segment counter is reset to zero.
5. Monostable D1 is fired to reset the 1024 counter to zero.

The voltmeter display counter accumulates pulses until a count of 3995 is achieved. Bistable B2 is then turned over by the output from its 3995 Decode circuit. Gate G5 opens and allows voltmeter V - F pulses, inverted by A, to pass into the 1024 counter. Gate G1 is inhibited by B2 during this action, closing G2.

The 1024 counter provides two sets of outputs :-

(1) Binary signals which are applied to slope generators in program units 1 and 2

(ii) signals on four lines which are encoded on to six lines for application to six AND gates in a break point decode circuit.

The contents of the segment counter, after reset by the LM 1420.2, are decoded and used to select gearbox ratios in the slope generators. Pulses from the 1024 Counter are geared down and the reduced output is directed through inverters D and E and a relay change-over contact to OR GATE G3. They are then taken through inverter B and the enabled AND gate G4 to the voltmeter display counter.

Further relay change-over contacts, situated between the Break Point Decode circuit and Segment Length circuits in the program units permit the decoded contents of the segment counter (used to select the gearbox ratio in the slope generators) to supply inputs to the six AND gates in the Break Point Decode circuit through one Segment Length circuit. When coincidence of inputs (from the 1024 Counter and Segment Length circuit) to an AND gate in the Break Point Decode circuit occurs, OR gate G6 supplies an input to AND gate G7.

This AND gate, previously enabled by the LINEARISE command signal, now issues an output through inverter C and OR gate G8 which fires monostable D1. The segment counter output is changed to select another slope generator ratio and another segment length output. The monostable also resets the 1024 counter to zero and allows it accumulate further pulses, until inputs to an AND gate in the Break Point Decode circuit again coincide to initiate a repeat of sequence of operations.

The numbering of the segment steps in each program has been arranged so that the part of the program written for negative temperature appears first and is followed by positive temperature segments. If an input of positive polarity is applied to the voltmeter, AND gate G9 opens due to the presence of LINEARISE and 'not 3995' commands. The gate output is inverted by F and applied through program selection relay contacts to one of two jump circuits in the program units. These circuits are linked through OR gates G11, G12 and G13 to the segment counter and their outputs move the counter to a pre-determined position.

Scaling

The command SCALE is effectively 'not linearise'. While the command is operative, the segment counter remains at zero (G10 inhibiting G8), and the slope generators are controlled by means of pre-wired plugs (not shown). The 3995 bistable is not turned over until a count of 3999 is reached, in order that scaling accuracy may not be impaired.

DVM Release

This command is applied to G1. It overrides any linearisation or scaling action by clamping G5 (the clamping input is not shown). G1 primes G2 and permits voltmeter V - F pulses to be returned directly to its display counter.

Circuit Details (see diagrams at rear of manual)

(a) Voltmeter Reset

A reset pulse from the voltmeter, generated at the collector of VT7, board 7, LM 1420.2 Voltmeter, is distributed to a number of circuits within the Lineariser, one being located in the base circuit of VT9, board 14659005. The positive reset pulse fires the monostable, driving VT9 into conduction and allowing it to cut off the barred sides of each bistable in the 1024 counter. In this condition the counter is reset to zero.

The voltmeter reset pulse is also passed through MR28, MR29, MR30, MR31, board 14659005, to reset the segment counter (see (b) below) to zero, at the start of the cycle.

When the end of segment is detected, an output pulse is generated by VT1, board 14659004, and is used to trigger the monostable. The end of segment pulse, delayed by 1.5 secs. by the monostable, is used to step the segment counter on one position and also reset the 1024 counter to zero. The delay is introduction to ensure that the 1024 counter has reached the end of the segment before it is reset.

Reference to figure 4 of the voltmeter handbook - the circuit diagram of the first decade of the Display Counter - shows a reset link between pin 5 (board 1) and pin 20 (board 2). This is disconnected when the Linearisers forms part of a system. The voltmeter reset pulse is applied to the junction of R17, R18, board 14659005, and, when LINEARISE is commanded (i.e. when pin X, PLB is not held at -12V by a DVM release signal), resets the units (first) decade of the voltmeter to 3, the full reset being to 3803 via pins P, R, S, T and U, PLB. 3603 or 3203 is produced if the x2 or x4 multipliers are in use. These resets are required because the Linearisers starts its law at 3995 and, on average, removes three digits between 3995 and 0000. As the voltmeter logic relies on the pulses not being modified before 0000, the removed digits must be compensated by reset to 3803.

Linearisation must begin at a voltmeter count of 3995. This is necessary because a voltmeter reading between 3995 and 3999 is complemented and use for polarity detection.

When RELEASE DVM is commanded the 3803 reset is inhibited and the first decade of the voltmeter is reset to zero through pin U, PLB, which links with pin 20, board 2, LM 1420.2

(b) Segment Counter and 1024 Counter.

The segment counter, identified as stages 1 to 4 of counter 3 on the circuit diagram, is a standard Solartron 5-bit Binary Counter, type LU 1437.2. A booklet describing the LU 1437.2 is provided as an appendix to this manual.

Initially the counter is reset by a positive edge from the Voltmeter to give a count of zero ($\overline{1} + \overline{2} + \overline{4} + \overline{8}$).

The 1024 counter comprises two type LU 1437.2 Counters (1 and 2) and the 5 stage of Counter 3 connected in series to give a count capability of 1024.

It accumulates pulses derived from the voltmeter V - F converter, directed through VT6 and VT12, board 14659005. Inputs are applied to pins 14 and 17 on all counters.

(c) Segment Decode

This circuit, accommodated on board 14659001, is operated from the segment counter via buffers VT1 to VT8. It decodes the counter outputs to provide 16 separate lines, 15 of which are applied to the Program Unit slope generator through SKTA or SKTB for use in that circuit and in the break point decode circuit on board 14659004.

Successive pulses to the counter energise plug PLB pins, as detailed in the table below:

TABLE 6 - SEGMENT DECODE OUTPUTS

Counter Output Decimal	B.C.D. 8 4 2 1	Energised Pins on SKTA or SKTB and PLA, Program Unit
0	0 0 0 0	-
1	0 0 0 1	21
2	0 0 1 0	20
3	0 0 1 1	19
4	0 1 0 0	18
5	0 1 0 1	17
6	0 1 1 0	16
7	0 1 1 1	15
8	1 0 0 0	14
9	1 0 0 1	13
10	1 0 1 0	12
11	1 0 1 1	11
12	1 1 0 0	10
13	1 1 0 1	9
14	1 1 1 0	8
15	1 1 1 1	7

(d) Slope Generators.

Pulses are fed from the 1024 counter to the generators - one is fitted to each Program Unit - through pins 41 to 50, SKTA or SKTB on the Lineariser and identical pins on PLA of the Program Units. Circuit details for Program Units LX 1511 to LX 1519 and LX 1689 are given at the rear of this manual.

Outputs from the 1024 conter are differentiated by capacitors C1 to C10. (Program Unit board A, 15119001) and fed via diodes MR1 to MR10 (board A) to the 10 turn winding around each transformer core (T1 to T10, Board A). Resistors R1 to R10, (board A), supply the counter with the current necessary to handle the capacitance loading, and resistors R11 to R20 (board A) discharge capacitors C1 to C10 before the next relevant edge from the counter.

The segment lines are connected to pins 7 to 21, PLA on the program unit and are energised in sequence by the segment counter. Each line connects an input through a decoupling network on board A of the Program Unit to a lace which passes through transformer cores of appropriate significance to obtain the required ratio. For example, Program Unit LX 1519 employs nine laces, which link pin 84 to pin 83 board A, etc., the first lace passing through the cores of T1, T3, T8, T9 and T10. Each lace extracts a proportion of the pulses applied to pins 41 to 50, PLA and routes them individually through MR11 or MR12 etc., (board A) to the read amplifier VT1, (board B).

The pulses are taken through pin 23, PLA of the Program Unit and pin 23, SKTA or SKTB of the Lineariser to an OR gate in the base circuit of VT9 (MM 1712), board 14659001. The transistor inverts the pulses and passes them through pin W, PLB of the Lineariser to the Display Counter in the Voltmeter.

The selected segment line is taken to a positive potential of such a value that its associated diode (one of MR11 to MR26 Program Unit Board A) supplies the d.c. condition required by the read amplifier, via the selected lace. During this period, the remaining segment lines are held at a potential required to cut off their associated diodes.

Capacitors C11 to C26 decouple input noise and prevent interaction between laces.

(e) Break Point Distance Decode

Each selected segment line also supplies one input to a two-input break point distance decode AND gate on board 14659004.

When the break point decode number is reached - obtained from Counter 2 or the 5 stage of Counter 3 - AND gate MR1, MR2 or AND gate MR5, MR6, etc., board 14659004, opens and, during linearisation, drives VT1, board 14659004 into conduction through OR gate MR12, MR13, MR15, MR16, MR18 and MR20, board 14659004.

VT1, board 14659004, is controlled by the command 'Linearise'. While this command is operative, emitter follower VT11, board 14659005, saturates VT2, board 14659004 and so connects the collector of VT1, board 14659004 to its -6V supply rail. VT1, board 14659004, fires monostable VT9, VT10, board 14659005, to reset the 1024 Counter and move the segment counter forward by one bit.

Another segment line now controls the pulse gearing process in the slope generator and the above cycle of operations is repeated.

It will be noted that slope generator inputs, taken from the non-carry sides of the bistables in the 1024 Counter, do not coincide with one another. Diagram 6 below illustrates this feature, the 512 line indicating the output of the1 stage of Counter 1, etc.

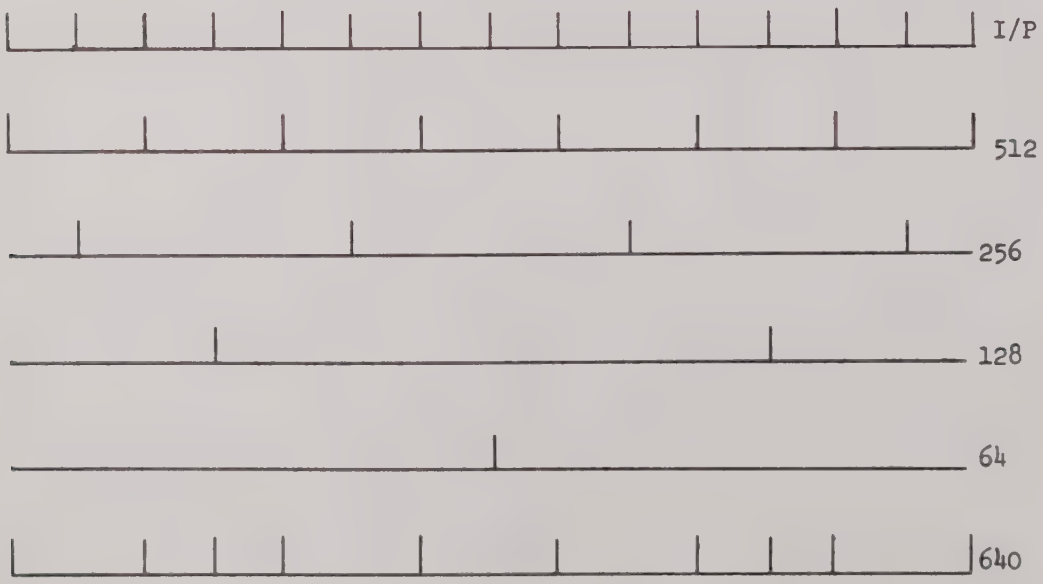


Diagram 6 : Slope Generator Inputs.

NOTE: 1. The '1' bistable changes state 512 times in 1024, hence giving the 512 line output. Succeeding bistables give proportionately reduced outputs.

2. The 640 example line is composed of 512 line and 128 line outputs.

(f) Program Unit Selection

The break points of the two programs are selected by the contacts of relays RLA and RLB. Relay operation is controlled by the state of conduction of VT3, board 14659004, the transistor being driven by -12V at pin C, PLB when program 2 is required or held off by the absence of the -12V level when program 1 is selected.

(g) Scaling

The command 'Scale' is equivalent to 'not Linearise'. Emitter follower VT11, board 14659004, cuts off VT2, board 14659004, and so disconnects the collector supply to VT1, board 14659004, holding the Segment Counter at its '0' position. At the same time, the potential at the junction of R15, R16 and MR22, board 14659004 is adjusted to a level suitable for the operation of the circuit associated with R36, C26 on Program Unit board A. Pins 24 and 2, SKTA, Program Unit are linked by means of a scaling plug which also connects windings, of appropriate scaling significance, on transformers T1 to T10, board A. The desired ratio of pulses is routed via MR26, board A and the read amplifier VT1, board B to VT9, board 14659001 and the Display Counters of the Voltmeter.

(h) DVM Release

In this mode of operation, positive going pulses from VT6, board 14659005, derived from the voltmeter V - F converter, are returned to the voltmeter through MR13 and C1, board 14659005 and MR35 and VT9, board 14659001. Operation of VT12, board 14659005, is inhibited by the -12V supply at pin X, PLB, which gives an input to MR14 in the OR gate MR9, MR14, board 14659005. See, also '(j) 3995 Bistable' overleaf.

(j) 3995 Bistable

This bistable, VT4/VT5, board 14659004, is turned over by the -24V supply through R26 when the inputs to the diode AND gate in the base circuit of VT4 are negative, indicating a voltmeter count of 3995 in the LINEARISE mode. VT4 conducts and permits inverted voltmeter V - F pulses from VT6, board 14659005, to cut off VT12, board 14659005, and allow positive going pulses from VT12 collector to be applied to pins 14 and 17 of Counter 1.

To permit accurate scaling, the bistable is fed with a count of 3999 in the Scale mode.

The bistable is reset by the positive voltmeter reset pulse applied to pin V, PLB and directed to the base of VT4 through MR27. In this reset condition, VT4 collector permits the operation of AND gate MR8, MR13, board 14659005, via MR9 and R19, board 14659005, allowing voltmeter pulses into the Display Counter before linearisation commences.

(k) Jump Instructions

The first segments of each program are used to linearise negative inputs, if available. When such inputs are not provided, a positive polarity signal at pin Y, PLB together with outputs of appropriate level from the collectors of VT2 and VT5, board 14659004 deliver a pulse through C7, board 14659005 to VT6, board 14659004. VT6 output is taken through pin 28, PLA, Program Unit and associated diodes to the segment counter, jumping the counter to the position required for the program in use.

If positive polarity is not called, VT5 board 14659004 fires the monostable VT9, VT10 board 14659005, on its negative edge.

Diodes MR40 and MR44, board 14659005, inhibit the jump drive circuitry during scaling.

(l) 2300 Bistable

While the 3995 bistable is in its '3995' state, the 2N1302 transistor (VT7 board 14659004) inhibits the diode AND gate in the base circuit of VT7, board 14659005, preventing operation of the 2300 bistable VT7, VT8, board 14659005 before 3995 is reached. The three remaining inputs, associated with MR10, MR11 and MR12 go negative when the voltmeter count reaches 2300.

Coincidence of inputs turns over the 2300 bistable, replacing the -12V supply to the collector load of VT9 (14659001) by the 0V at the collector of VT7 (2300 bistable). The MI 1712, in this condition, prevents further pulses being applied to the voltmeter through pin A, PLB, avoiding a meaningless count in excess of 2300.

Power Supply LS 1656

A mains transformer T1, with two 0V - 115V primary windings, is used. They may be connected in series for 230V working or in parallel for 115V working, by means of mains selector plug MSP1.

Two 18V and two 6V d.c. supplies are generated, with respect to the basic reference line connected to the centre taps of the two secondary windings of T1. By connecting the emitter of VT3 to system common rail (chassis), the potential of each supply line is lowered by 6V to give +12V, -24V, -6V, 0V and -12V outlets required by the Lineariser. The supplies are generated by means of conventional full-wave rectification, series stabilisation, zener reference techniques.

SECTION 4

TEST PROCEDURE

Introduction

The procedure given in this section is basically the production test to which all units are subjected prior to despatch. It is provided to enable the user to confirm the performance of the unit and to make any necessary adjustments.

Equipment

(a) Multi-Range Test Meter, 20000 Ω/V.

(b) Oscilloscope, Solartron CD 1220 or similar.

(c) Variac, or similar device to vary the mains input.

(d) It is assumed that the module is incorporated in a Compact Logger or similar system.

Access

Release the free connectors and remove the wing-nut at the rear of the module. Ease the module out of its cabinet and position it on the bench in such a way that the free connectors which were attached to it may be re-attached through extension leads. A 50-way plug and a 50-way socket, compatible with the free and fixed connectors and linked together by insulated leads, about 3 ft long in a 'One-to-one' pin arrangement, will be suitable for signal coupling. Cables with suitable connectors will be required for the power supplies.

Remove the two holding screws at the right-hand side panel of the module (viewed from the front) and lower the panel. The printed circuit boards may now be hinged out for servicing.

Initial Checks

(a) Ensure that the mains selector plug (LU 1656) is set to the correct voltage tapping and check the rating of the mains fuse, as described in Section 2.

(b) On board PCB 14659005, check that the following supplies are within the quoted limits.

(i) -6V between pins 41 and 49 (± 0.5V limit)

(ii) -12V between pins 47 and 49 (± 1V limit)

(iii) -24V between pins 44 and 49 (± 3.6V limit)

(iv) +12V between pins 48 and 49 (± 1.8V limit)

Vary the supply voltage (by means of a Variac) between the limits 95V to 130V or 190V to 260V, ensuring that the three low voltage rails remain within their specified tolerances.

Test Sequence

(a) Apply a known input to the Voltmeter via the system Scanner. Use the Scanner function output, corresponding to the channel in use, to command DVM RELEASE. A -12V signal is now applied to pin X, PLB. The Voltmeter reading should agree with the value of the known input.

(b) Apply a known input, within the range of program 1 inputs, to the Voltmeter via the system Scanner. Use the Scanner function output, corresponding to the channel in use, to command the unit to LINEARISE. A -12V signal is now applied to pin B, PLB. Set the Voltmeter to x 1, x 2 or x 4, according to program 1 requirements. Check that the voltmeter display corresponds to the known input, within the limits specified. Information relating temperature to voltage may be obtained from the thermocouple tables BS 1827 : 1952 issued by the British Standards Institution, British Standards House, 2 Park Street, London, W.1.

(c) Repeat(b) using inputs covering the complete range of Program Unit 1.

(d) Repeat (b) and (c) for Program Unit 2. Program change-over is achieved by energising pin C, PLB from the system Scanner.

(e) Wire a Blue Ribbon scaling plug, supplied as an accessory to the unit to set up a known ratio (see Section 2). Insert the plug in the PROG. 1 socket and note the Voltmeter reading after applying a known input to the instrument. Compare it with the Voltmeter reading when the unit is operated in the RELEASE DVM mode. The second reading multiplied by the scaling factor (n - 1024) should be equal to the first reading.

(f) Repeat (e) for Program 2.

Program Units, which require servicing, should be returned to this company.

SECTION 5

PROGRAM UNIT DETAILS

The information contained in the following pages (21 to 30) should be read in conjunction with the Program Unit Circuit Diagram at the rear of this manual.

PROGRAM UNIT LX1511 (Iron/Constantan, -50°C to +230°C)

(a) Transformer Decode Wiring

Pairs of pins on Program Unit Board A (15119001) are linked together through transformer cores on the same board. Details are given below:

From Pin	Through cores of Transformers.	To Pin
84	T1, T8	83
82	T1, T5, T9	81
80	T2, T3, T4, T5, T6, T8	79
78	T2, T3, T4, T5, T7, T8	77
76	T2, T3, T4, T5, T9	75
74	T2, T3, T4, T6, T7, T8	73
72	T2, T3, T4, T6, T7	71
70	T2, T3, T4, T6, T9	69
68	T2, T3, T4, T6	67
66	T2, T3, T4, T7, T8	65
64	T2, T3, T4, T7, T8	63
62	T2, T3, T4, T7, T8	61
60		59
58		57
56		55
54		103

(b) Diode Connections

Forward - biassed diodes (MR1 to MR12 & MR17) link the following pins on board B (15119002).

Diode	From Pin	To Pin	Diode	From Pin	To Pin	Diode	From Pin	To Pin
MR12	21	17	MR8	25	17	MR4	29	17
MR11	22	17	MR7	26	17	MR3	30	17
MR10	23	17	MR6	27	17	MR2	31	17
MR9	24	17	MR5	28	17	MR1	32	17
MR17	7	5	MR16	6	5			

(a) Transformer Decode Wiring

Pairs of pins on Program Unit Board A (15119001) are linked together through transformer cores on the same board. Details are given below:

From Pin	Through cores of Transformers	To Pin
84	T2, T3, T4, T5, T7, T8	83
82	T2, T3, T4, T6, T7	81
80	T2, T3, T4, T7, T8	79
78	T2, T3, T4, T6	77
76	T2, T3, T4, T6	75
74	T2, T3, T4	73
72	T2, T3, T5, T6, T7	71
70	T2, T3, T5, T8	69
68	T2, T3, T6, T7, T8	67
66	T2, T3, T6	65
64	T2, T3, T7, T8	63
62		61
60		59
58		57
56		55
54		103

(b) Diode Connections

Forward - biassed diodes (MR1 to MR11 & MR16) link the following pins on board B (15129002).

Diode	From Pin	To Pin	Diode	From Pin	To Pin	Diode	From Pin	To Pin
MR11	22	13	MR7	26	13	MR3	30	15
MR10	23	13	MR6	27	14	MR2	31	14
MR9	24	13	MR5	28	15	MR1	32	13
MR8	25	13	MR4	29	15	MR16	6	5

PROGRAM UNIT LX1513 (Copper/Constantan, -130°C to +390°C)

(a) Transformer Decode Wiring

Pairs of pins on Program Unit Board A (15119001) are linked together through transformer cores on the same board. Details are given below:

From Pin	Through cores of Transformers	To Pin
84	T1, T3, T4	83
82	T1, T2, T4	81
80	T1, T2, T3, T4, T5, T7	79
78	T1, T3, T6	77
76	T1, T4, T8	75
74	T1, T7, T8	73
72	T2, T3, T4, T5, T7	71
70	T2, T3, T4, T7, T8	69
68	T2, T3, T5, T6, T7	67
66	T2, T3, T5, T7	65
64		63
62		61
60		59
58		57
56		55
54		103

(b) Diode Connections

Forward - biassed diodes (MR1 to MR10 & MR18) link the following pins on board B (15139002)

Diode	From Pin	To Pin	Diode	From Pin	To Pin	Diode	From Pin	To Pin
MR10	23	13	MR6	27	13	MR2	31	12
MR9	24	13	MR5	28	13	MR1	32	12
MR8	25	13	MR4	29	12	MR18	8	5
MR7	26	13	MR3	30	12			

PROGRAM UNIT LX1514 (Chromel/Alumel, -100°C to +1300°C)

(a) Transformer Decode Wiring

Pairs of pins on Program Unit Board A (15119001) are linked together through transformer cores on the same board. Details are given below:

From Pin	Through cores of Transformers	To Pin
84	T1, T3, T5	83
82	T1, T2	81
80	T1, T4, T5, T6, T8	79
78	T1, T4, T5, T6	77
76	T1, T4, T5, T6, T7, T8	75
74	T1, T4, T5, T7, T9	73
72	T1, T4, T6, T7, T9	71
70	T1, T4, T6, T7, T8	69
68	T1, T4, T5, T7, T9	67
66	T1, T3, T9	65
64	T1, T3, T5	63
62	T1, T3, T4, T6	61
60		59
58		57
56		55
54		103

(b) Diode Connections

Forward - biassed diodes (MR1 to MR12 & MR16, MR17) link the following pins on board B (15149002).

Diode	From Pin	To Pin	Diode	From Pin	To Pin	Diode	From Pin	To Pin
MR12	21	15	MR8	25	15	MR4	29	13
MR11	22	15	MR7	26	15	MR3	30	13
MR10	23	15	MR6	27	15	MR2	31	13
MR9	24	15	MR5	28	13	MR1	32	12
						MR17	7	5
						MR16	6	5

PROGRAM UNIT LX1515 (Chromel/Alumel, -50°C to +230°C)

(a) Transformer Decode Wiring

Pairs of pins on Program Unit Board A (15119001) are linked together through transformer cores on the same board. Details are given below:

From Pin	Through cores of Transformers	To Pin
84	T1, T3, T5, T7	83
82	T1, T3, T4, T6, T7, T8	81
80	T1, T3, T7	79
78	T1, T4, T5, T6	77
76	T1, T4, T5, T7	75
74	T1, T4, T5, T7, T9	73
72	T1, T4, T5, T7	71
70	T1, T3	69
68	T1, T4, T5, T6, T7, T8	67
66	T1, T4, T5, T6, T7, T9	65
64		63
62		61
60		59
58		57
56		55
54		103

(b) Diode Connections

Forward - biassed diodes (MR1 to MR10 & MR16, MR17) link the following pins on board B (15159002)

Diode	From Pin	To Pin	Diode	From Pin	To Pin	Diode	From Pin	To Pin
MR10	23	17	MR6	27	17	MR2	31	15
MR9	24	17	MR5	28	17	MR1	32	17
MR8	25	17	MR4	29	17	MR16	6	5
MR7	26	17	MR3	30	17	MR17	7	5

PROGRAM UNIT LX1516 (Platinum/Platinum(13% Rhodium), -5°C to +1600°C)

(a) Transformer Decode Wiring

Pairs of pins on Program Unit Board A (15119001) are linked together through transformer cores on the same board. Details are given below:

From Pin	Through cores of Transformers	To Pin
84	T1, T2, T5, T6, T7, T8	83
82	T1, T3, T4, T5	81
80	T1, T3	79
78	T1, T5, T6, T7, T8	77
76	T1, T6, T7	75
74	T2, T3, T4, T5, T6, T8, T9	73
72	T2, T3, T4, T6, T8, T9	71
70	T2, T3, T4	69
68	T2, T3, T5, T7	67
66	T2, T3, T6, T7, T9	65
64	T2, T3, T7, T8, T9	63
62	T2, T3	61
60	T2, T4, T5, T6, T8	59
58	T2, T4, T5, T7, T10	57
56	T2, T4, T5, T7, T8, T9	55
54		103

(b) Diode Connections

Forward - biassed diodes (MR1 to MR16) link the following pins on board B (15169002)

Diode	From Pin	To Pin	Diode	From Pin	To Pin	Diode	From Pin	To Pin
MR15	18	17	MR9	24	15	MR3	30	13
MR14	19	17	MR8	25	15	MR2	31	12
MR13	20	17	MR7	26	15	MR1	32	12
MR12	21	15	MR6	27	15	MR16	6	5
MR11	22	15	MR5	28	13			
MR10	23	15	MR4	29	13			

PROGRAM UNIT LX1517 (Platinum/Platinum(10% Rhodium), -5°C to +1600°C)

(a) Transformer Decode Wiring

Pairs of pins on Program Unit Board A (15119001) are linked together through transformer cores on the same board. Details are given below:

From Pin	Through cores of Transformers.	To Pin
84	T1, T2, T4, T6	83
82	T1, T3, T4, T5, T7	81
80	T1, T3, T5, T7	79
78	T1, T4, T5, T7, T8, T9	77
76	T1, T4, T8	75
74	T1, T5, T7, T9	73
72	T1, T6, T8	71
70	T2, T3, T4, T5, T6, T7, T8	69
68	T2, T3, T4, T5, T7	67
66	T2, T3, T4, T6, T8, T9	65
64	T2, T3, T4, T8, T9	63
62	T2, T3, T4	61
60	T2, T3, T5, T7	59
58	T2, T3, T5, T8, T9	57
56	T2, T3, T5, T7, T8	55
54		103

(b) Diode Connections

Forward - biassed diodes (MR1 to MR16) link the following pins on board B (15179002)

Diode	From Pin	To Pin	Diode	From Pin	To Pin	Diode	From Pin	To Pin
MR15	18	17	MR10	23	15	MR5	28	13
MR14	19	17	MR9	24	15	MR4	29	13
MR13	20	15	MR8	25	15	MR3	30	12
MR12	21	15	MR7	26	15	MR2	31	12
MR11	22	15	MR6	27	13	MR1	32	12
						MR16	6	5

PROGRAM UNIT LX1518 (Platinum Resistance 130Ω/100Ω Thermometer, -5°C to +1000°C)

(a) Transformer Decode Wiring

Pairs of pins on Program Unit Board A (15119001) are linked together through transformer cores on the same board. Details are given below:

From Pin	Through cores of Transformers.	To Pin
84	T1, T3, T7, T8	83
82	T1, T3, T6, T7, T8	81
80	T1, T3, T5, T7	79
78	T1, T3, T4	77
76	T1, T3, T4, T6, T7	75
74	T1, T3, T4, T5, T7	73
72	T1, T3, T4, T5, T6, T7, T8	71
70	T1, T2, T5, T7, T8	69
68	T1, T2, T5, T6, T7, T8	67
66	T1, T2, T4, T5, T8	65
64	T1, T2, T3, T7	63
62	T1, T2, T3, T5, T6, T7	61
60		59
58		57
56		55
54		103

(b) Diode Connections

Forward - biassed diodes (MR1 to MR13) link the following pins on board B (15189002).

Diode	From Pin	To Pin	Diode	From Pin	To Pin	Diode	From Pin	To Pin
MR12	21	13	MR8	25	13	MR4	29	13
MR11	22	13	MR7	26	13	MR3	30	13
MR10	23	13	MR6	27	13	MR2	31	13
MR9	24	13	MR5	28	13	MR1	32	13
						MR13	6	5

(a) Transformer Decode Wiring

Pairs of pin on Program Unit Board A (15119001) are linked together through transformer cores on the same board. Details are given below:

From Pin	Through cores of Transformers.	To Pin
84	T1, T3, T8, T9, T10	83
82	T1, T3, T7, T8, T9, T10	81
80	T1, T3, T8, T9	79
78	T1, T3, T7, T8	77
76	T1, T3, T6, T9, T10	75
74	T1, T3, T6, T7, T9, T10	73
72	T1, T3, T5	71
70	T1, T3, T5, T8, T9	69
68	T1, T3, T5, T7, T8, T10	67
66		65
64		63
62		61
60		59
58		57
56		55
54		103

(b) Diode Connections

Forward - biassed diodes (MR1 to MR11) link the following pins on board B (15199002).

Diode	From Pin	To Pin	Diode	From Pin	To Pin	Diode	From Pin	To Pin
MR9	24	17	MR6	27	17	MR3	30	17
MR8	25	17	MR5	28	17	MR2	31	17
MR7	26	17	MR4	29	17	MR1	32	17
						MR10	6	5
						MR11	7	5

(a) Transformer Decode Wiring

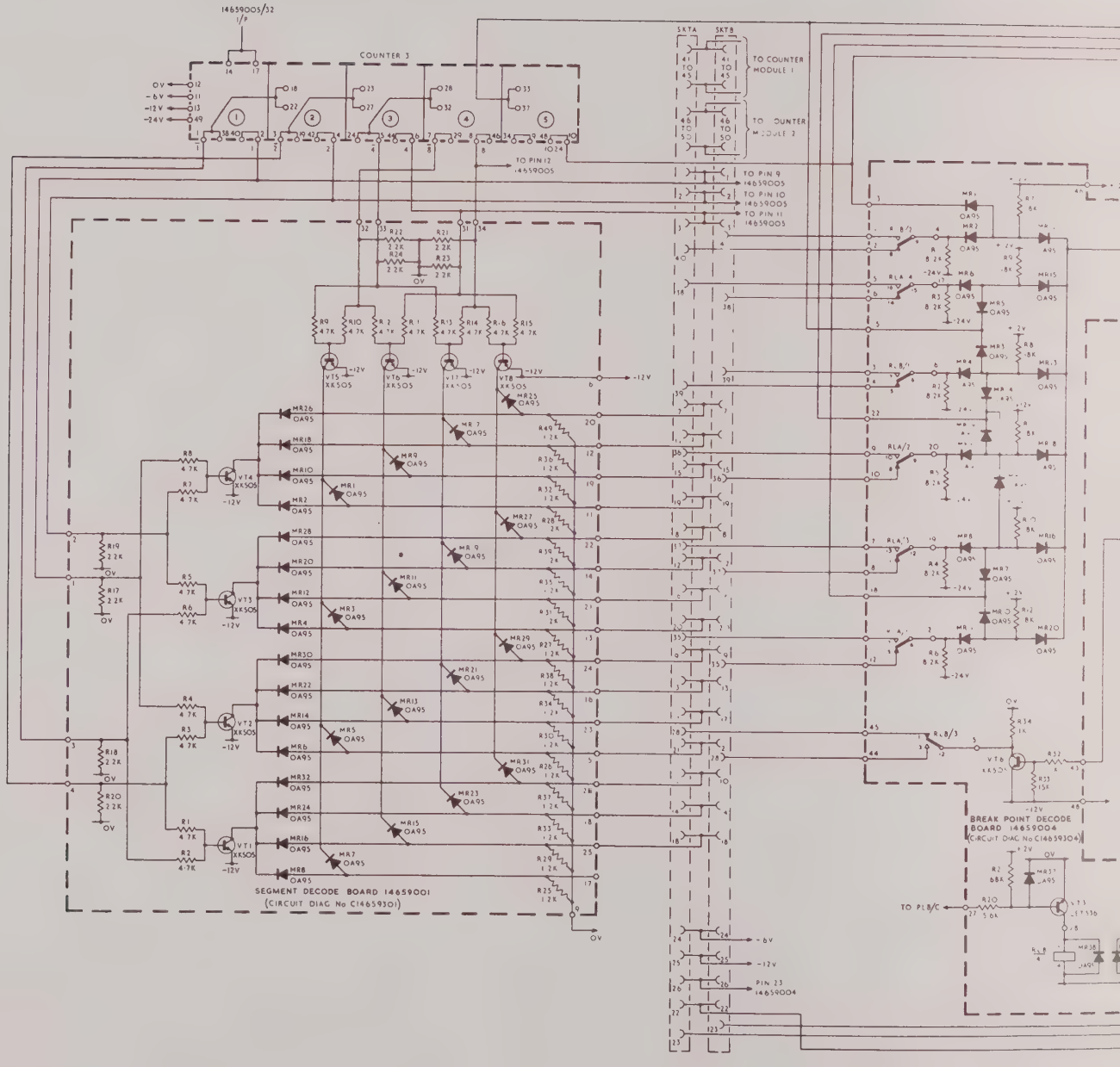
Pairs of pins on Program Unit Board A (15119001) are linked together through transformer cores on the same board. Details are given below:

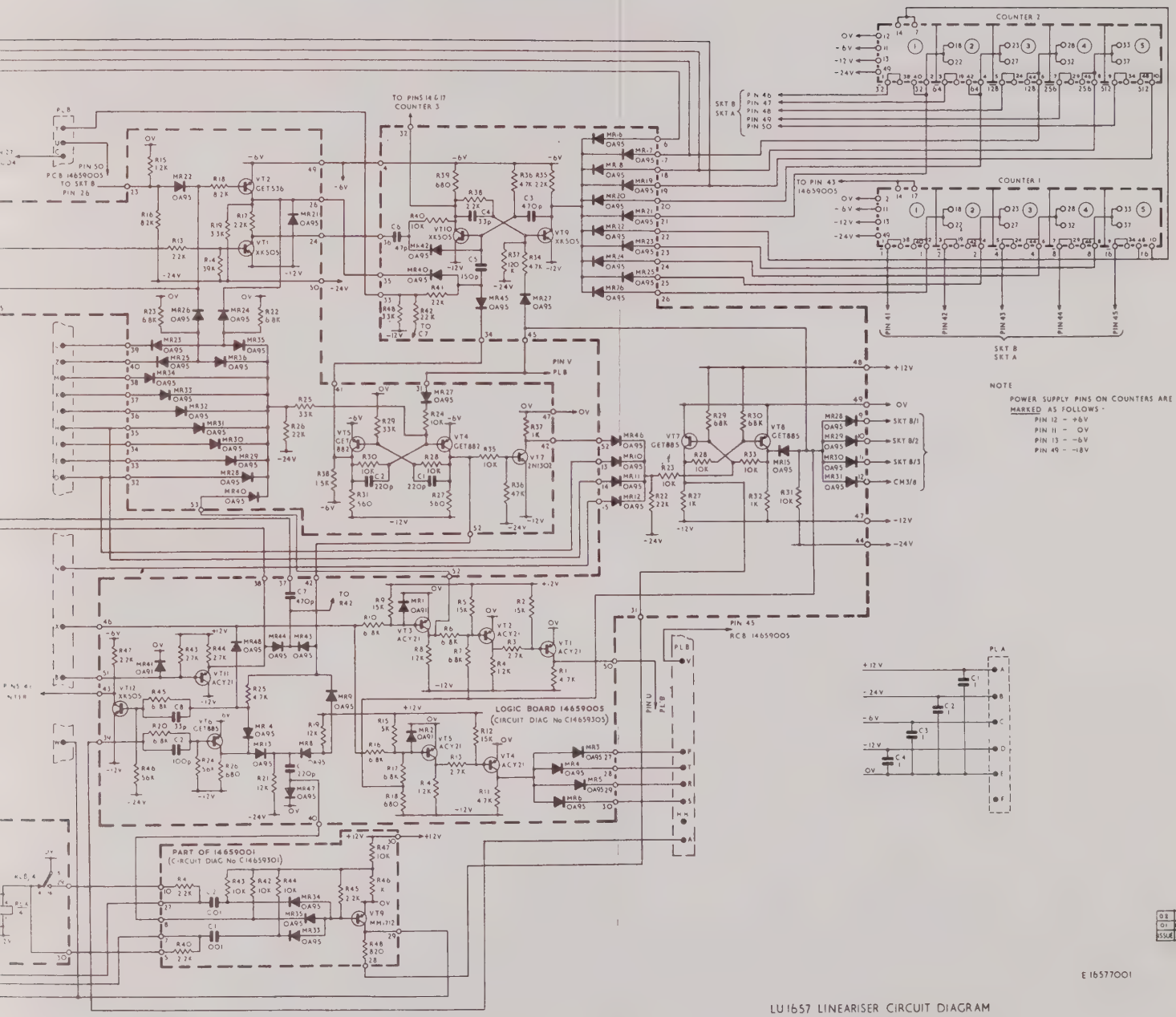
From Pin	Through cores of Transformers	To Pin
84	T1, T3, T5, T6, T7	83
82	T1, T3, T4, T5, T6, T8	81
80	T1, T3, T8	79
78	T1, T4, T6, T7, T8, T9	77
76	T1, T5, T6, T7, T8, T9	75
74	T1, T5, T7	73
72	T1, T6, T9	71
70	T1, T9	69
68	T2, T3, T4, T5, T6	67
66	T2, T3, T4, T5, T8, T9	65
64	T2, T3, T4, T6, T7, T8	63
62		61
60		59
58		57
56		55
54		103

(b) Diode Connections

Forward - biassed diodes (MR1 to MR11 and MR16, MR17) link the following pins on board B (16899002).

Diode	From Pin	To Pin	Diode	From Pin	To Pin	Diode	From Pin	To Pin
MR11	22	16	MR7	26	17	MR3	30	17
MR10	23	17	MR6	27	17	MR2	31	16
MR9	24	17	MR5	28	17	MR1	32	17
MR8	25	17	MR4	29	17	MR16	6	5
						MR17	7	5


14659005/32
I/P
COUNTER 3
SKTA
SKTB
TO COUNTER MODULE 1
TO COUNTER MODULE 2
TO PIN 12 14659005
TO PIN 9 14659005
TO PIN 10 14659005
TO PIN 11 14659005
SEGMENT DECODE BOARD 14659001
(CIRCUIT DIAG No C14659301)
BREAK POINT DECODE BOARD 14659004
(CIRCUIT DIAG No C14659304)
TO PL B/C
PIN 23 14659004



NOTE

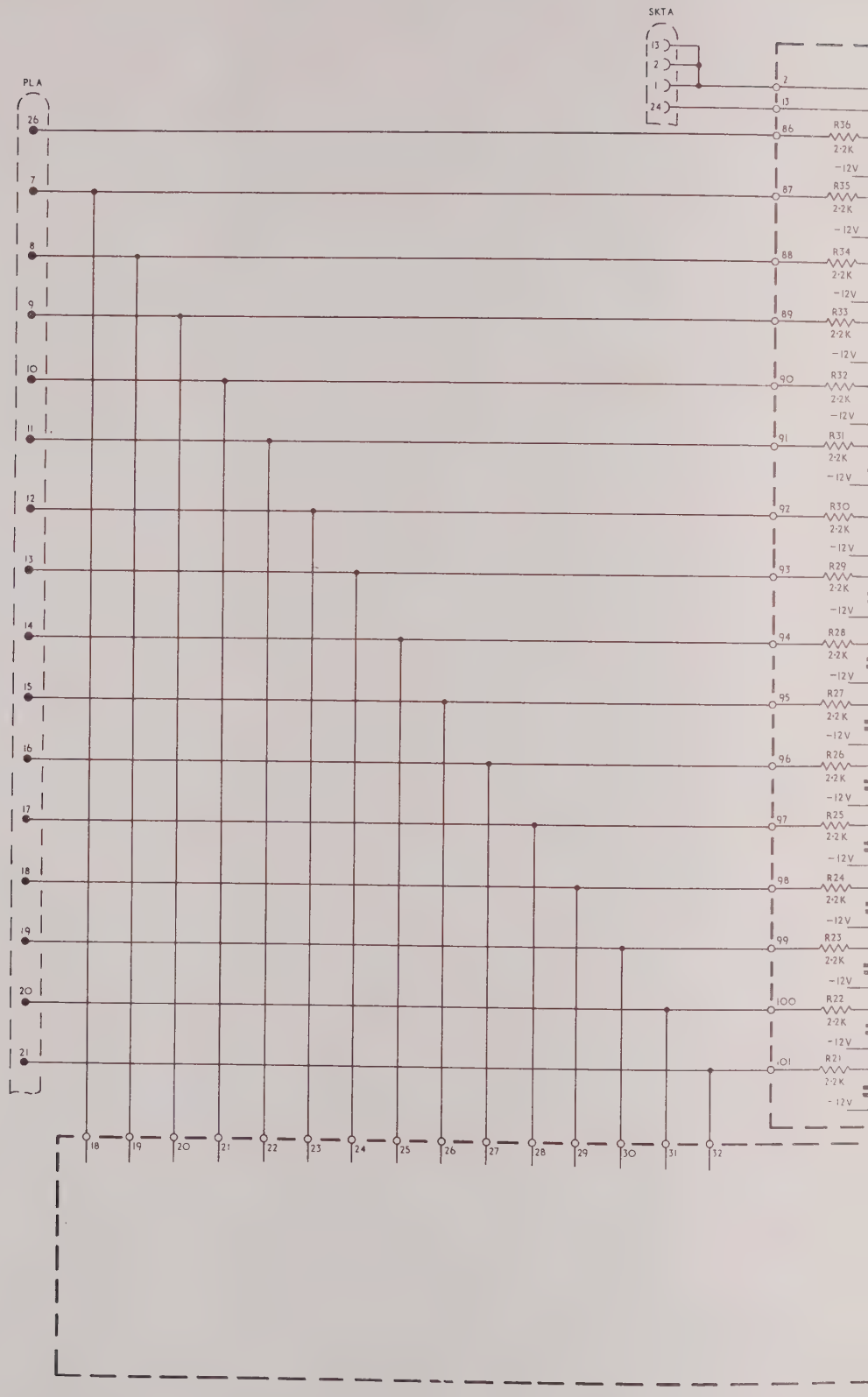
POWER SUPPLY PINS ON COUNTERS ARE MARKED AS FOLLOWS -

PIN 12 - +6V
PIN 11 - 0V
PIN 13 - -6V
PIN 49 - -18V

ISSUE	DATE
01	24 3 66

E 16577001

LU1657 LINEARISER CIRCUIT DIAGRAM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13
2
1
24
PLA
26
7
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100
101
R36
R35
R34
R33
R32
R31
R30
R29
R28
R27
R26
R25
R24
R23
R22
R21
2·2K
-12V
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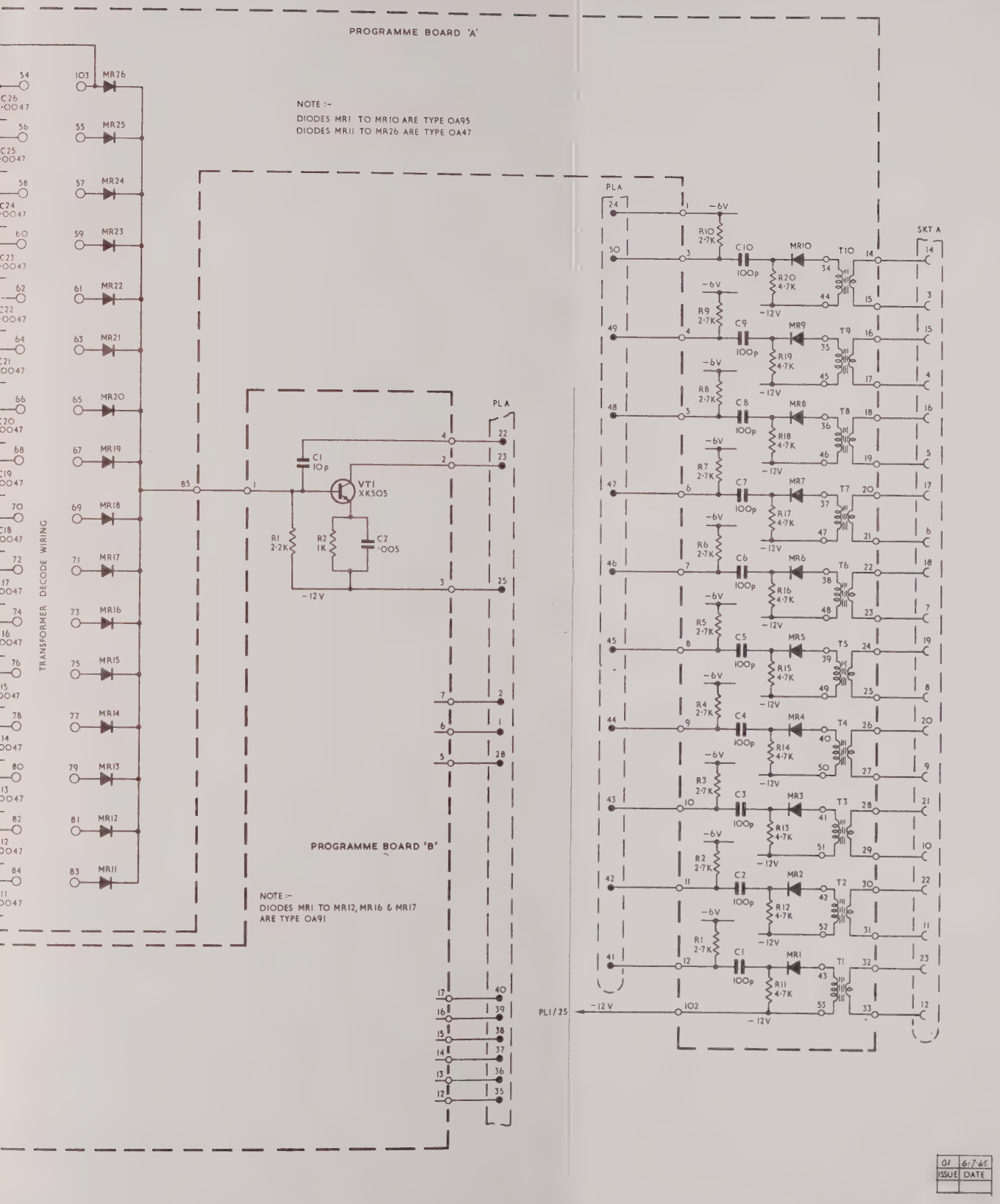
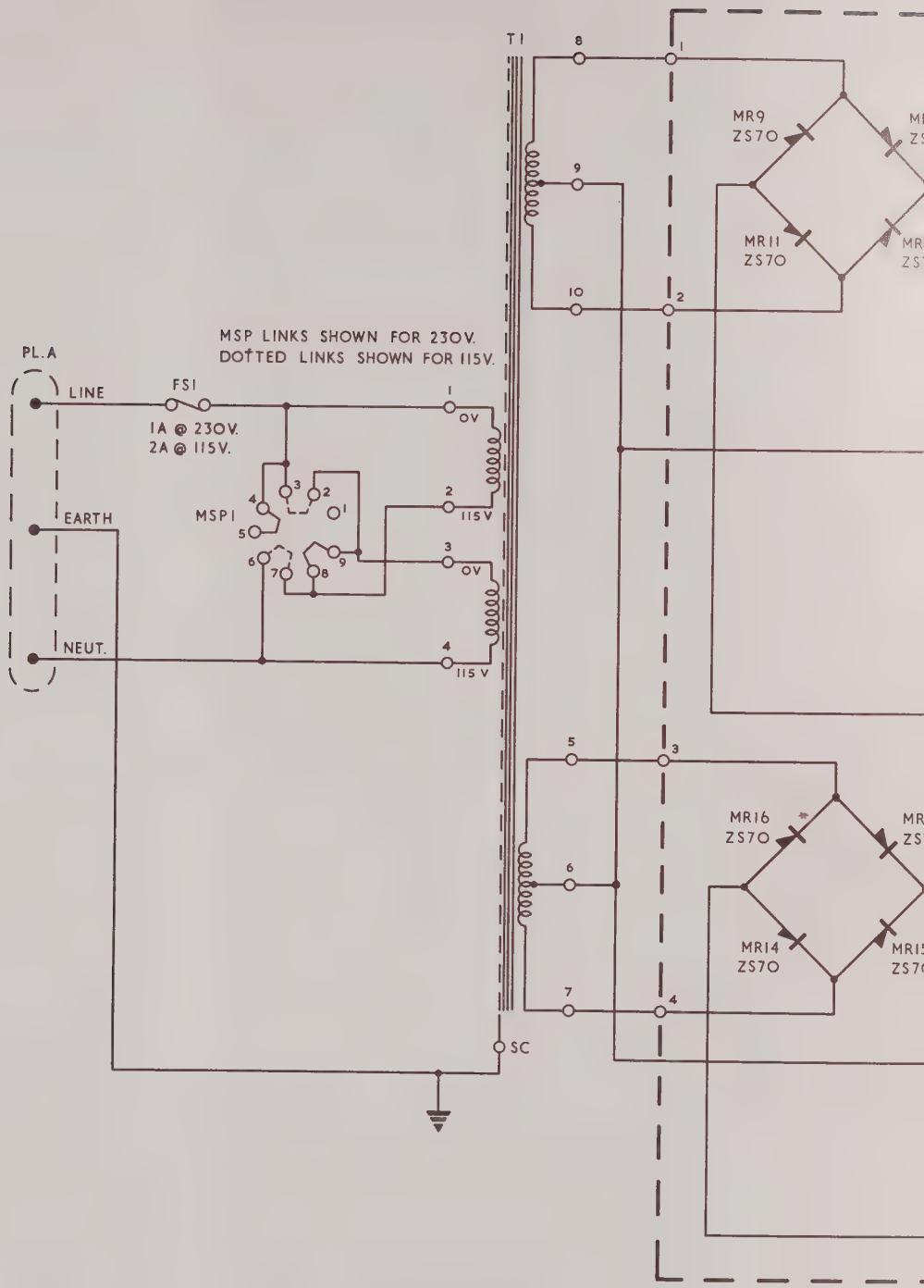
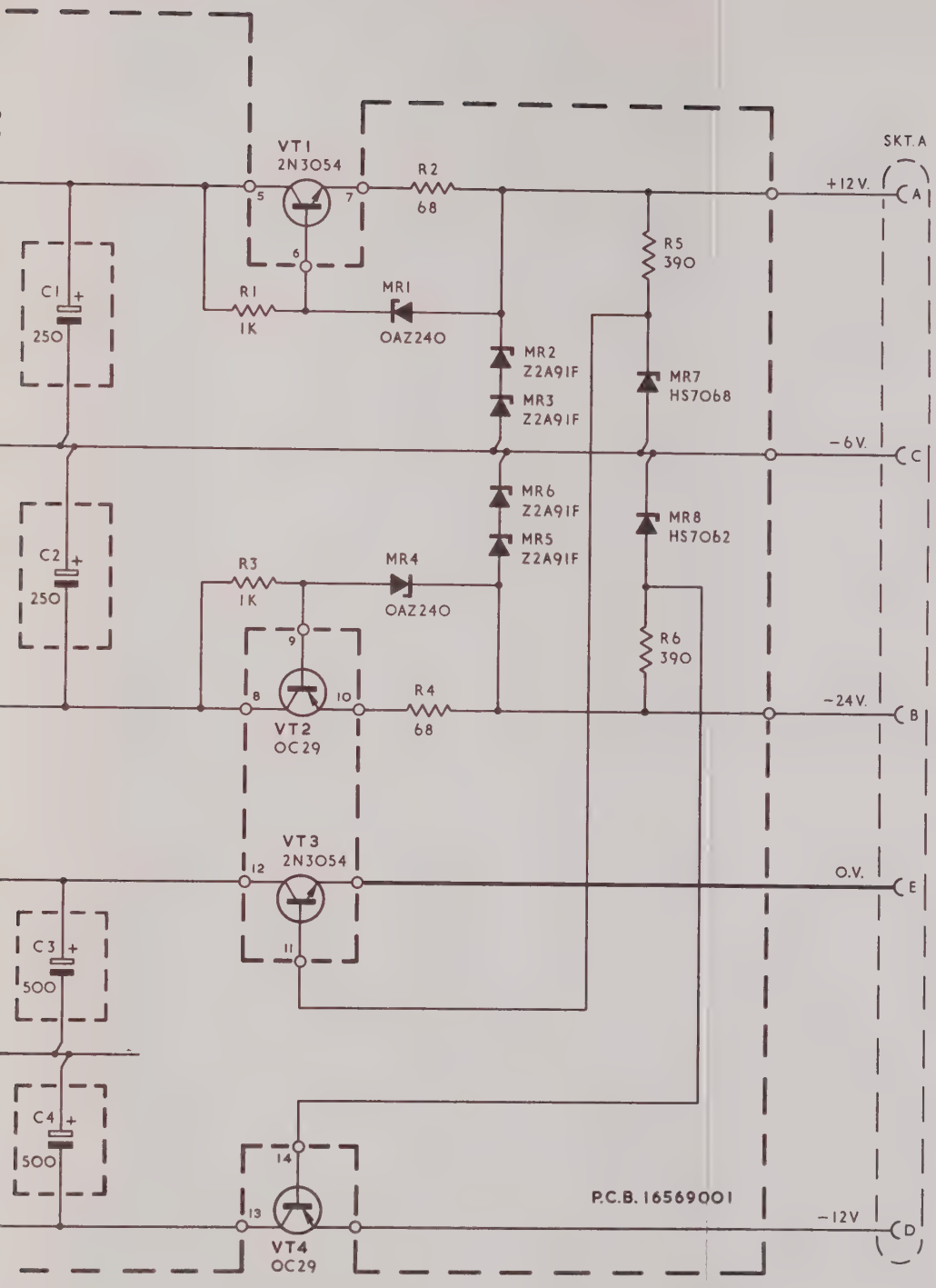


ISSUE	DATE
01	6.7.65

D 15117001

CIRCUIT DIAGRAM-LINEARISER PROGRAMME UNIT


T1
8
1
MR9
ZS70
9
MR11
ZS70
10
2
MSP LINKS SHOWN FOR 230V.
DOTTED LINKS SHOWN FOR 115V.
PL.A
LINE
FS1
1A @ 230V.
2A @ 115V.
1
0V
2
115V
3
0V
4
115 V
EARTH
MSP1
NEUT.
5
3
MR16
ZS70
6
MR14
ZS70
7
4
SC

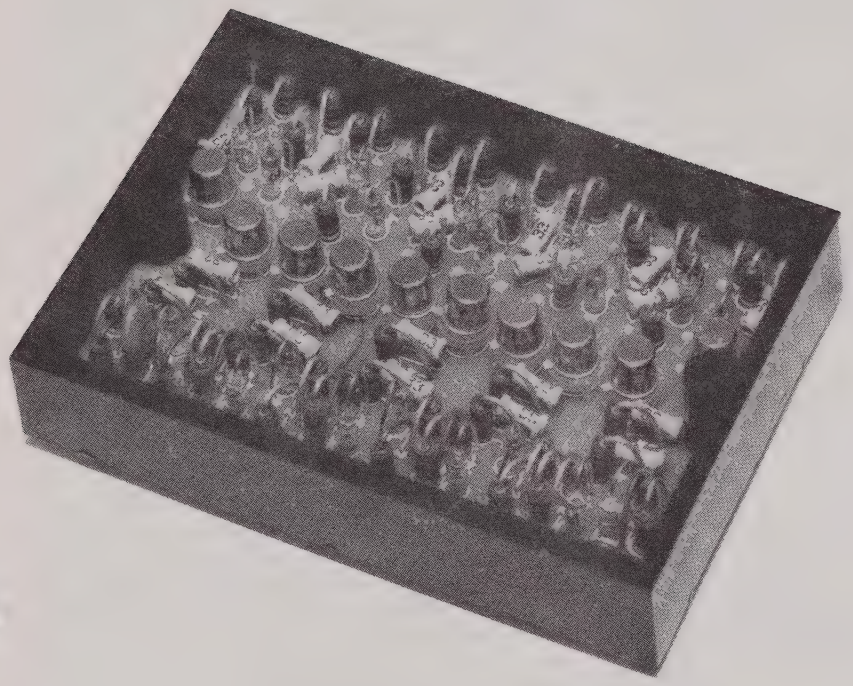


B	15·4·66
A	25·3·66

C16567001.

LINEARISER POWER SUPPLY
CIRCUIT DIAGRAM

FIVE-BIT BINARY COUNTER LU1437·2



TECHNICAL DATA

THE SOLARTRON ELECTRONIC GROUP LTD.
FARNBOROUGH · HAMPSHIRE · ENGLAND
TELEPHONE: 44433. CABLES: SOLARTRON, FARNBOROUGH, HANTS. TELEX: 85245 SOLARTRON FNBRO

PRINTED IN ENGLAND

LU 1437.2 is made up of five independent binary stages which may be connected to perform counting and logic operations at rates up to 1Mc/s. The bistable circuits are of conventional design. Each is fitted with input steering gates which have separate pulse input and control connections. A setting input facility (line) is also provided. Additionally there is a direct connection to each transistor base.

Data Summary

Counting Input:

Pulse Characteristics

Amplitude: 6V ± 1V
Risetime: 250nsec. maximum
100nsec. minimum
Falltime: 100nsec. maximum
25nsec. minimum.

Maximum counting rate:

1 Mc/s with 1:1 mark space ratio.

Logic Outputs:

With no external load:-
Information out:- -6V ± 0.5V
No information:- 0V ± 0.5V
Output resistance: 68Ω
Maximum external load/output: +5mA.
Maximum capacitive load/external output: 15pF + 30pF/mA external d.c. load.

Information Sets:

Bistable setting is enabled by an input on each stage.
Signal Levels/Set Input:
with stage outputs unloaded.

No Set Information	-6V	$^{+\ 0.5V}_{-\ 1V}$
Set Information	0V	$^{+\ 1V}_{-\ 0V}$

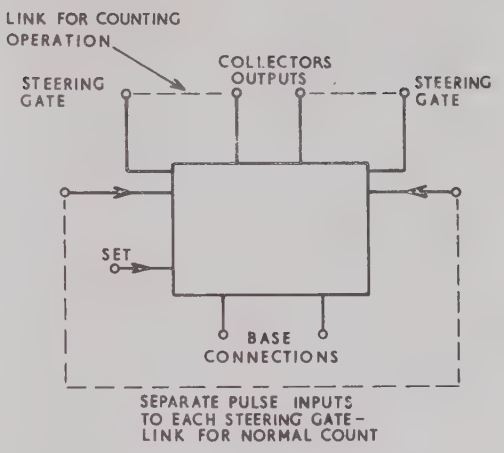
with full output load

No Set information	-6V	$^{+\ 1V}_{-\ 0V}$
Set information	-0V	$^{+\ 1V}_{-\ 0V}$

minimum application of set information 500nsec.

Power Supply Requirements:

+6V ± 0.5V at 19mA typical
-6V ± 0.25V at 18mA typical
-18V ± 1V at 1.5mA typical
(All referred to 0 volt line)



Operating Temperature Range: 0 - 60°C.
Dimensions: (inches) 2.960 x 2.080 x .629.
Fixing centres: 2.650, 2 holes .136 diameter.

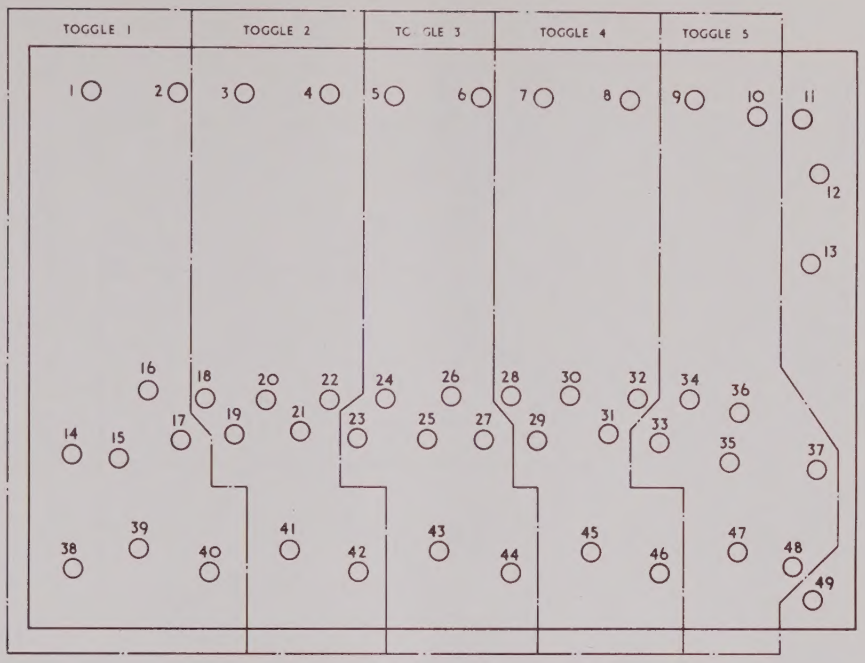
Circuit Description.

Consider one of the five toggle circuits which make up the unit. For use as a simple binary counter, pulse inputs 1 and 2 are connected together and the input is applied between them. Steering inputs 1 and 2 are connected to collectors 1 and 2 respectively.

In this configuration the steering capacitors charge to the potential of their associated collectors. The input pulse is differentiated by the input circuit time constant producing positive and negative going spikes of amplitude slightly less than the driving waveform. The bias state of the steering diodes is such that the full negative charge is applied to the base of the 'on' transistor switching it off and so causing the bistable to change state.

The steering resistor connections, when linked to the collectors enable operation as a normal binary stage, as described above. However, they may also be used to provide external control of the gate circuit when connection to a 0 volt point inhibits the gate and taking the resistor connection to -6 volt opens the gate.

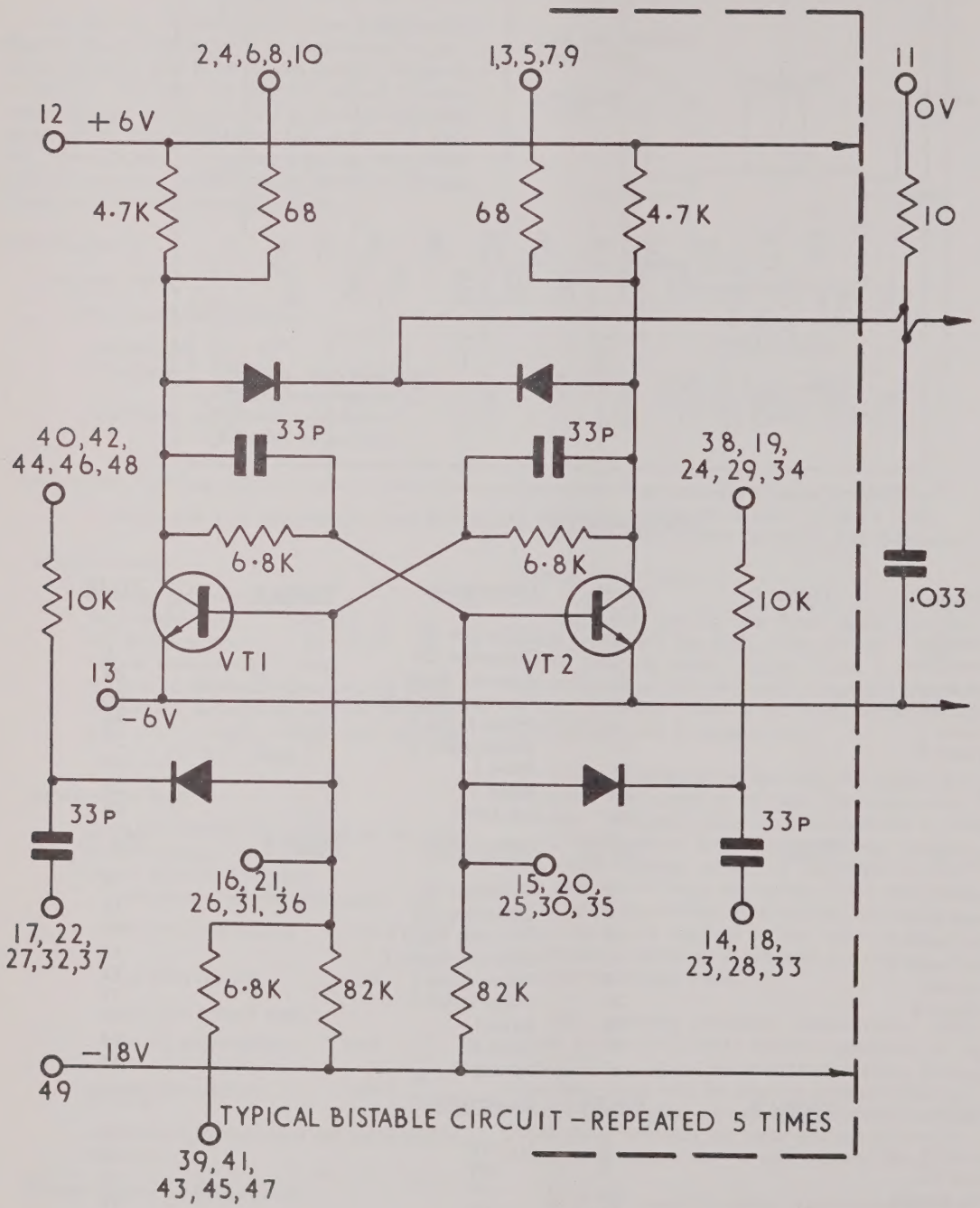
A 6 volt positive-going pulse of duration 500nsec. or longer applied to the 'set' input will switch its associated transistor 'on'. The base connections enable the toggle circuits to be switched to either state on application of a suitable input.



Pin Connections LU 1437-2

Description	Toggle 1	Pin No.	Description	Toggle 4	Pin No.
Collector C1		1	Collector C1		7
Collector C2		2	Collector C2		8
Steering Input 1		38	Steering Input 1		29
Steering Input 2		40	Steering Input 2		46
Pulse Input 1		14	Pulse Input 1		28
Pulse Input 2		17	Pulse Input 2		32
Base 1		15	Base 1		30
Base 2		16	Base 2		31
Set Input		39	Set Input		45
Description	Toggle 2	Pin No.	Description	Toggle 5	Pin No.
Collector C1		3	Collector C1		9
Collector C2		4	Collector C2		10
Steering Input 1		19	Steering Input 1		34
Steering Input 2		42	Steering Input 2		48
Pulse Input 1		18	Pulse Input 1		33
Pulse Input 2		22	Pulse Input 2		37
Base 1		20	Base 1		35
Base 2		21	Base 2		36
Set Input		41	Set Input		47
Description	Toggle 3	Pin No.	Description		Pin No.
Collector C1		5	0V		11
Collector C2		6	+6V		12
Steering Input 1		24	-6V		13
Steering Input 2		44	-18V		49
Pulse Input 1		23			
Pulse Input 2		27			
Base 1		25			
Base 2		26			
Set Input		43			

Pin Connections LU 1437-2



Typical Bistable Circuit - Repeated 5 Times

MP MASTER
MA24420

SEG

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